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Observations on the edge of the forest in the Kodiak region of Alaska*

ROBERT F. GRIGGS

(WITH ONE TEXT FIGURE)

As is well known, the western limit of the Alaskan spruce forest, composed of *Picea sitchensis*, crosses Kodiak Island. The forest on the northeastern portion of the Kodiak group of islands consists of fairly large trees forming a dense stand but further westward the trees are much smaller and grow only in the more sheltered situations, finally failing altogether. The last of them that we saw as we went down the outside coast were on Ugak Island while the furthest extension on the opposite inside coast is at Cape Uganik.

The edge of the coniferous forest is generally spoken of as the edge of the forest but it is by no means the limit of arborescent growth. For both the paper birch, *Betula papyrifera alaskana*, and the cottonwood, *Populus balsamifera*, though mapped by Harshberger† as terminating at the head of Cook Inlet, reach Kodiak Island and extend for many miles beyond the last spruce, growing abundantly in suitable habitats. In our trip around the island we saw the last of them on Two-headed Island, beyond which the country was a treeless grassland or tundra. Coming back on the opposite side we met them again at the entrance to Uyak Bay.

Our nearest stopping place to their limits was at Three Saints Bay. Here the birches occurred singly on the edges of the bogs, reaching a height of about fifteen feet. The poplars grew in clumps on the better drained land. They were about twenty feet tall and somewhat deformed but the deformation was somewhat less marked than in the outermost spruces. The largest plants were less than a foot in diameter. These small plants contrasted strongly with those seen later at Kalsin Bay about 55 miles northwestward, which were large trees 60–80 feet tall and 2 feet in diameter. Very much to our regret in view of the conditions later found on the edge of the spruce forest we did not obtain data as to the comparative ages of these trees.

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* Contribution from the Botanical Department of the Ohio State University, No. 81. The writer's opportunity to visit this interesting region came with his employment during the summer of 1913 as scientist in kelp investigations by the Bureau of Soils of the United States Department of Agriculture.

† Harshberger, J. W. Phytogeographic survey of North America. Veg. der Erde 13. 1911.

As opportunity presented, observations were made on the fruiting habits of the spruce and the birch; the poplar was not seen in fruit. Most of the trees of both species bore little fruit but some few of them were fruiting copiously. This matter varies much, however, from season to season. Fernow* reports that the year 1898 was a heavy seed year for the spruces, which bore an enormous crop of cones, which, turning brown and persisting on the branches through the summer of 1899, "gave the trees at a distance the appearance of having been killed by fire."

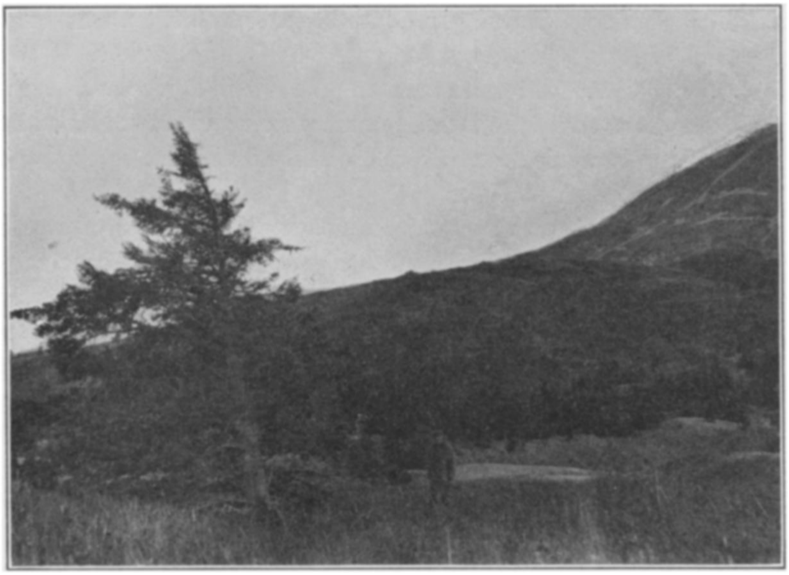

FIG. 1. Stunted Alaskan spruce (*Picea sitchensis*) on Afognak Island, near the edge of its range.

Near the edge of the spruce forest it appeared very evident that conditions were unfavorable for growth, and that the trees were barely able to maintain themselves. When growing alone their shape contrasted strikingly with the familiar slender spires seen further east. They were squatty and broad with thick stocky trunks (FIG. 1) and evidently grew very slowly. They did better when growing in clumps but the dependence of the individuals on the protection of the clump as a whole was very striking. Regardless of the age of the trees there was a very definite clump-contour beyond which no single branch projected. The growth of the individual members was evidently conditioned on that of the clump. Each tree was kept in exact proportion to its neighbors. The trees in the center were the tallest while those near the edges were progressively shorter and shorter until those on the edges were nearly as much dwarfed as those standing alone.

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* Fernow, B. E. The forests of Alaska. Harriman Alaska Exped. 2: 245. 1910.

Apparently here was what I had looked for in vain in studying species on the edges of their ranges in the Sugar Grove area of Ohio,* namely a species which had reached the limits imposed by climatic conditions so that it could go no further. The climatic extreme in this case would appear to be Merriam's "Effective Temperature Factor" which has been positively assigned as the cause by Piper,† who says "Undoubtedly this effective temperature factor is the principal cause of the sharp demarkation between the timbered and timberless regions on the Alaska coast."

As far as observation could determine, then, here was a clear-cut case of a species which had reached the limits imposed on its extension by its adaptability to climatic conditions. But as a matter of fact this is not at all the case for *the edge of the range of the spruce is not held stationary but is advancing rapidly.*

The advance is so rapid that it is evident to persons who have lived in Kodiak only a few years. According to Mr. M. D. Snodgrass of the Experiment Station all of the old men of Kodiak remember when there were but a few trees on Woody Island which is now heavily forested. On Near Island there are large numbers of young trees coming in on land that was never forested before.

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* Griggs, R. F. Observations on the behavior of some species on the edges of their ranges. Bull. Torrey Club **41**: 25–49. *f. 1–6.* 1914.

† Piper, C. V. The grasslands of the South Alaska coast. U. S. Dept. Agr. Bur. Pl. Ind. Bull. 82: 27. 1905.

Mr. Snodgrass himself has observed the advance of the spruce on the station lands at the head of Kalsin Bay, which is within a few miles of the extreme edge of the range. Land which was prairie pasture six years ago when he came to Kodiak is now growing up in spruce.

This unstable condition of the edge of the forest has already been reported by Fernow* who says:

"There is some evidence that this western limit is not, or may not remain, stable—that the spruce has wandered in recent times and may still wander. There is also evidence that the treeless country beyond, made up of the Alaska peninsula and the Aleutian Islands, is not incapable of growing trees.

"An interesting evidence of the progress of the spruce may be seen on Long Island, a few miles east of Kadiak, where an extensive spruce grove has established itself within the last century. Many trees had been freshly cut and a count of the rings showed none older than ninety or a hundred years. While on Kadiak and Wood Islands the oldest growth was found to be between 125 and 150 years with some few rotten stumps possibly older. This difference in age of entire groves so near together allows the inference that the older has furnished seed for the younger and that the spruce has wandered from Kadiak to Long Island."

It might seem a simple matter of arithmetic to determine from the data at hand the rate of advance of the spruce forest. This however is not the case. The probability is that the advance goes by long jumps at considerable intervals of time. Fernow (l. c.) pointed out that it is conditioned on the conjunction of a good seed-year and a favorable wind, the prevailing winds being adverse. The limits of the spruce which he reports are exactly the same as those we observed after an interval of fourteen years. It must be clear also that after one step forward, further advance is delayed until the trees along the newly established boundary begin to fruit and in their turn supply seed for further invasion. Thus while it may be that there was no actual advance during this fourteen-year period, it is clear from Mr. Snodgrass's experience that the vanguard has been spreading over the newly acquired territory and strengthening itself, so to speak, for another move forward.

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* Fernow, B. E., *l. c.* 244.

The advancing forest at Kodiak is peculiarly significant because it is a typical example of the kind of evidence upon which most of the assumptions of static plant ranges have been based. The edges of the forests more than any other vegetational lines have been used to show the correlation of plant ranges with climatic factors. Such work is all based on an assumption of complete adjustment of plants to climate and loses its significance wherever such adjustment does not exist, i. e., wherever the ranges are not fixed but changing. Our knowledge of the conditions obtaining at the limits of forests except in a few cases has all been derived from reports by travelers of stunting and apparent struggle against climatic extremes has seemed conclusive just as similar observations appeared conclusive to the writer at Kodiak. In few cases has the history of the regions been examined to find the actual facts.

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